

SOME INTERESTING SEALS RELATED ANALYSES

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Some Interesting Seals Related Analyses

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Some Interesting Seals Related Analyses

BW Seals
Durametallic Seals
Pacific Wietz Seals
Pac-Seal

Overview

Sample challenging analyses

- Demands on Mechanical Seals
- Pressure induced stator waviness
- Redesigning for a seal retainer a resonance away from excitation
- Ideas needed for STLE STC

Advanced Projects Subcommittee



Fluid Sealing Division

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Exacting Demands on Mechanical Seal Surfaces

- Low leakage • Remain close
- Low friction • Remain **flat**
- Low wear • Remain **steady**
- Low heat • Remain parallel
- Low cost • Not need replacement



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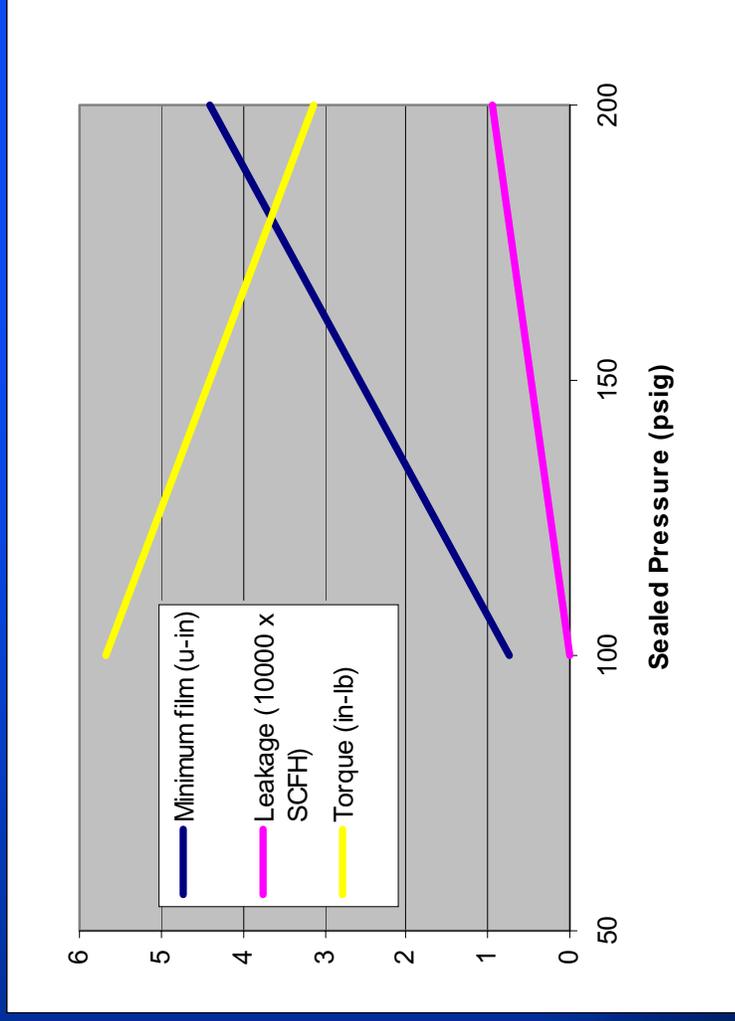
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Hydrostatic liquid-lubricated pressure-balanced plain seal

Expected behavior with increasing pressure:

- Leakage increases
- Film thickness increases
- Torque decreases



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Pressure induced stator waviness

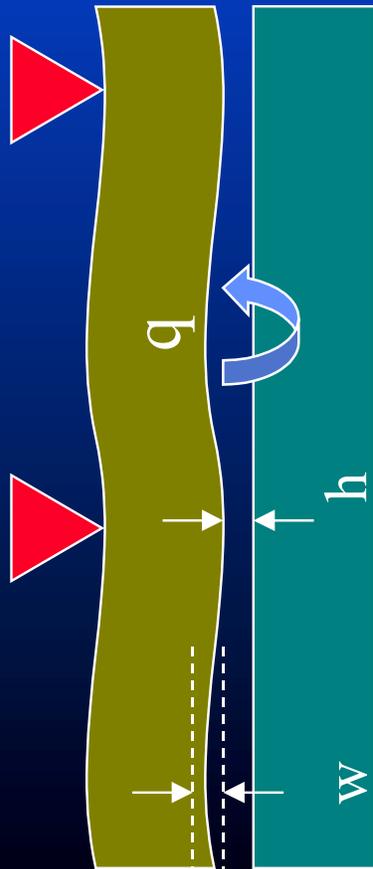


Seals
Seals

Pac-Seal

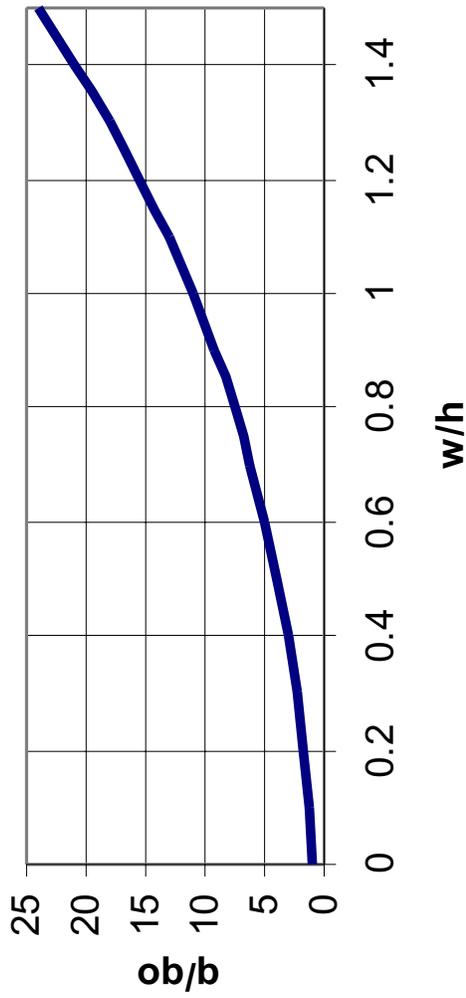
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Waviness causes radial leakage



$$q := h^3 + 3 \cdot h^2 \cdot w + \frac{9}{2} \cdot h \cdot w^2 + \frac{5}{2} \cdot w^3$$

Leakage factor versus waviness



- But stator face was flat....
- 3-point support
- stator support surface flat?
- could pressure cause waviness?

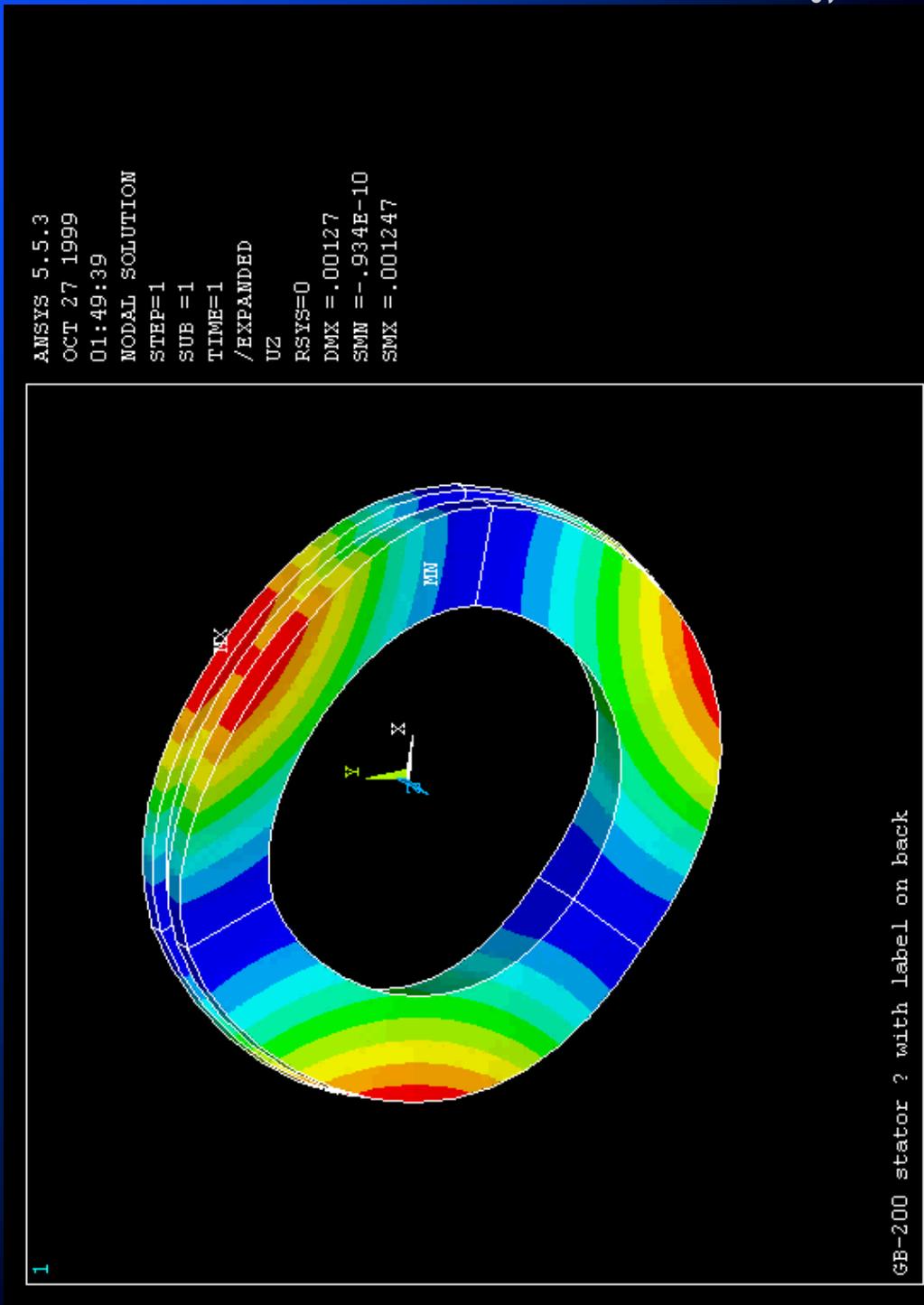


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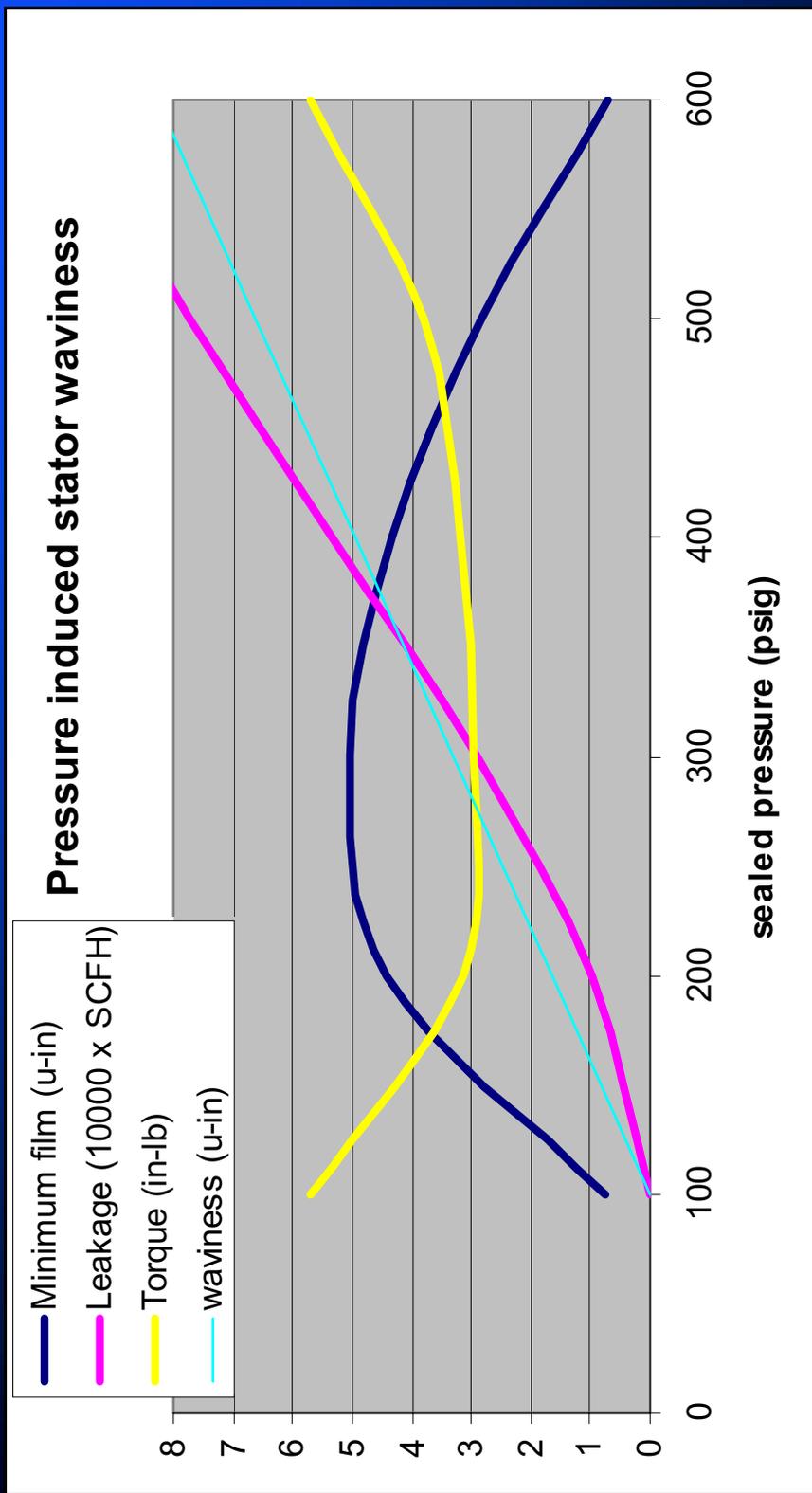
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3-D model of ring loaded by pressure on 3 high spots on support



Pressure induced stator waviness

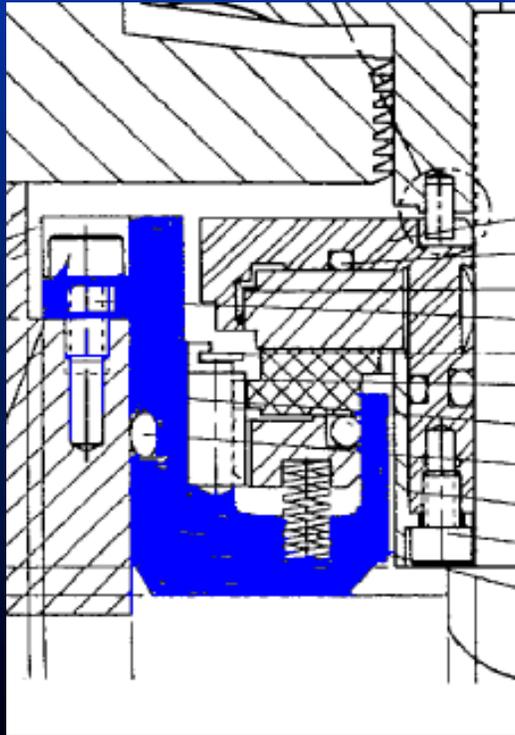


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Seal holder resonance



Excitation frequencies	
Hz (14X)	Hz (15X)
5089	5452

measured	FEA	
Bench test	Calculated	% error
4,675	original design	-1.5%
	4,700	0.5%
5,450	5,360	-1.7%
5,850	5,933	1.4%
6,275	6,283	0.1%
6,625	7,142	7.2%

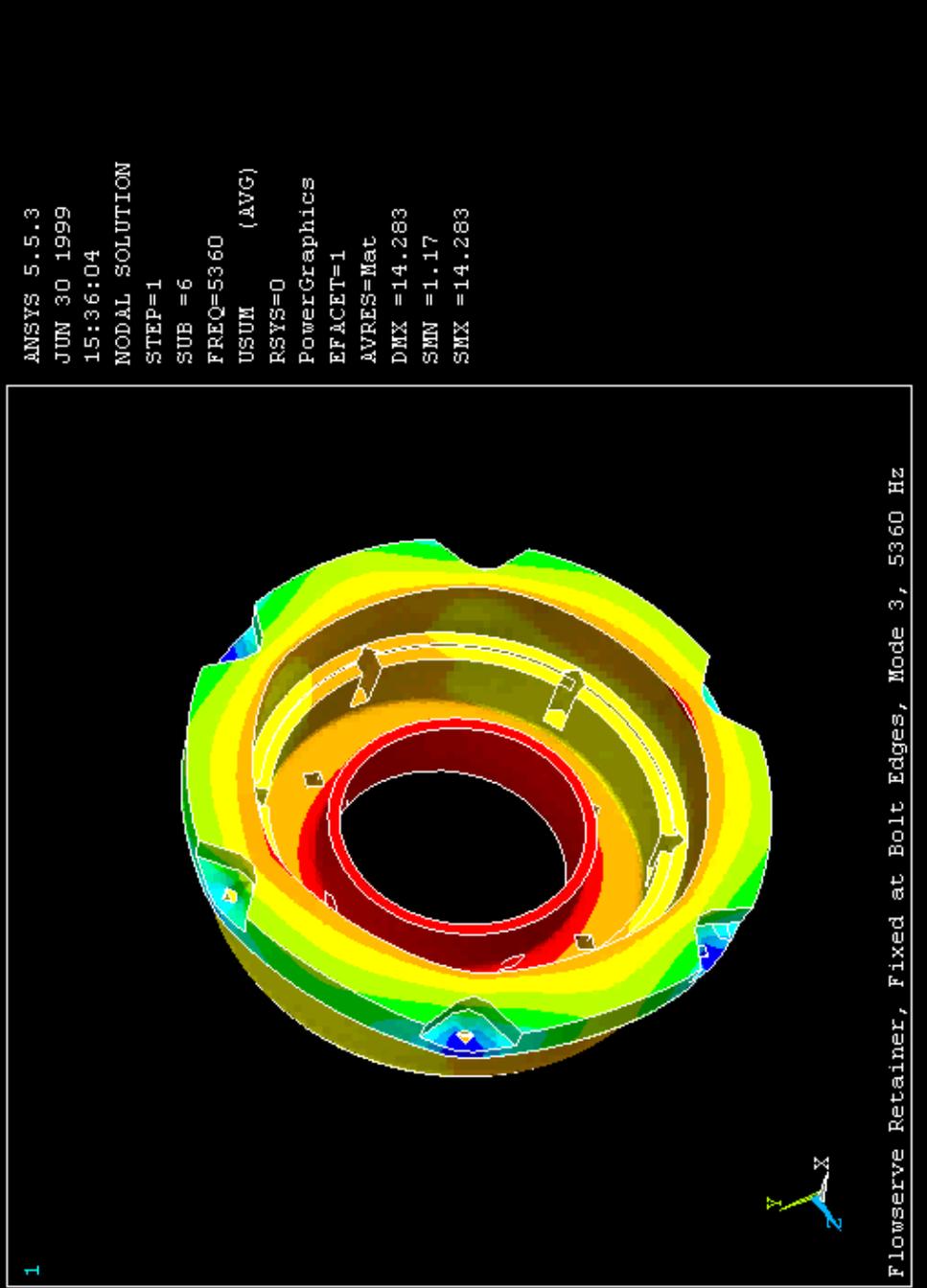


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Resonance at 5360Hz Nozzle passing frequency= 15Xrpm = 5450Hz

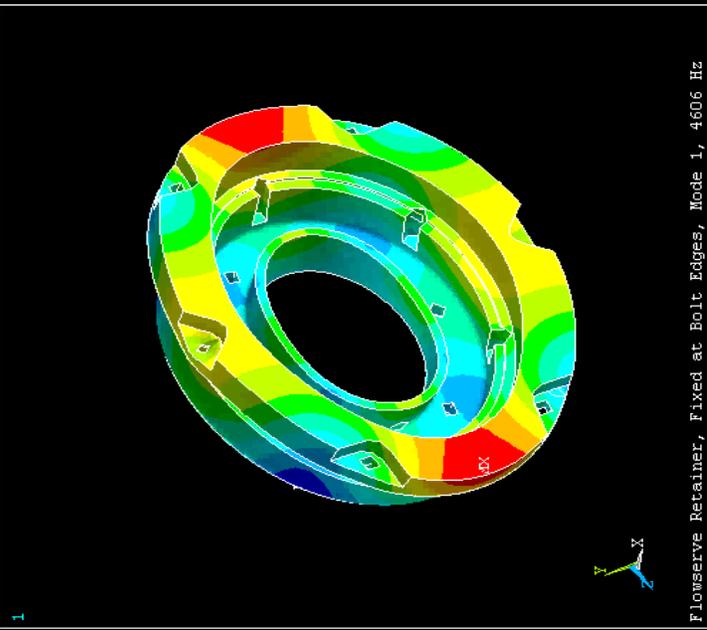


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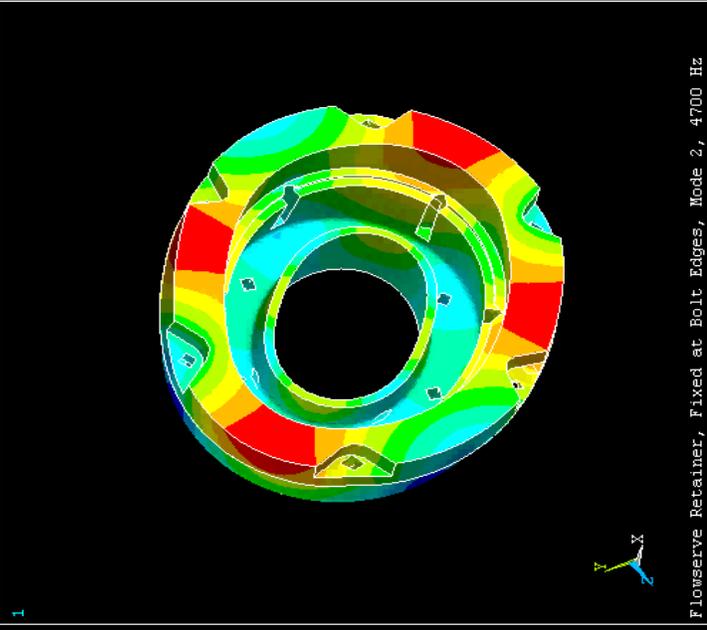
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1st and 2nd natural frequencies

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 SUB =4
 FREQ=4606
 USUM (AVG)
 RSYS=0
 PowerGraphics
 EFACET=1
 AVRES=Mat
 DMX =21.93
 SMN =1.43
 SMX =21.93



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 SUB =5
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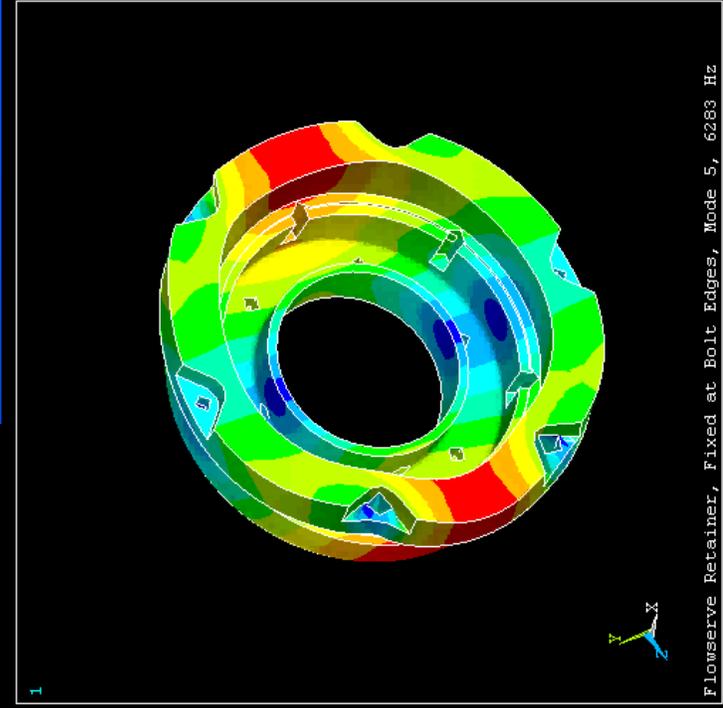
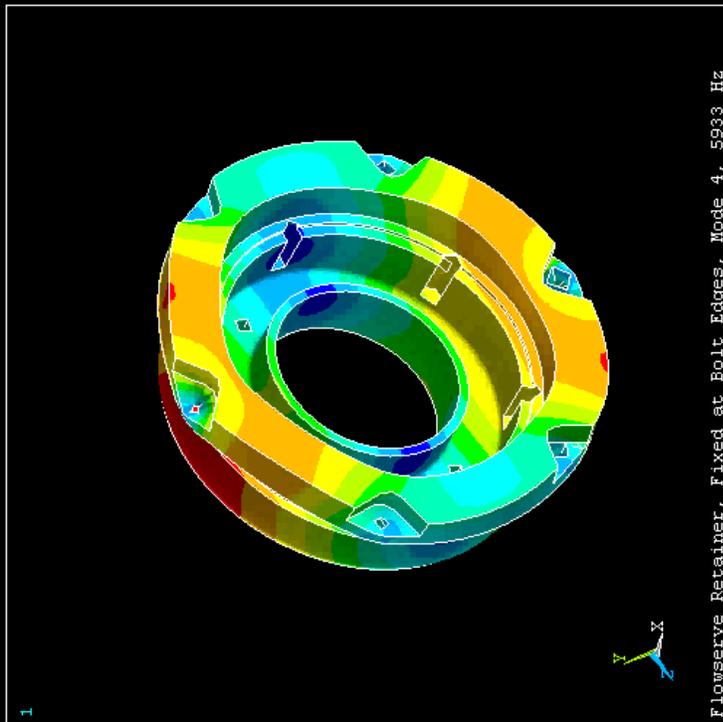


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4th & 5th natural frequencies

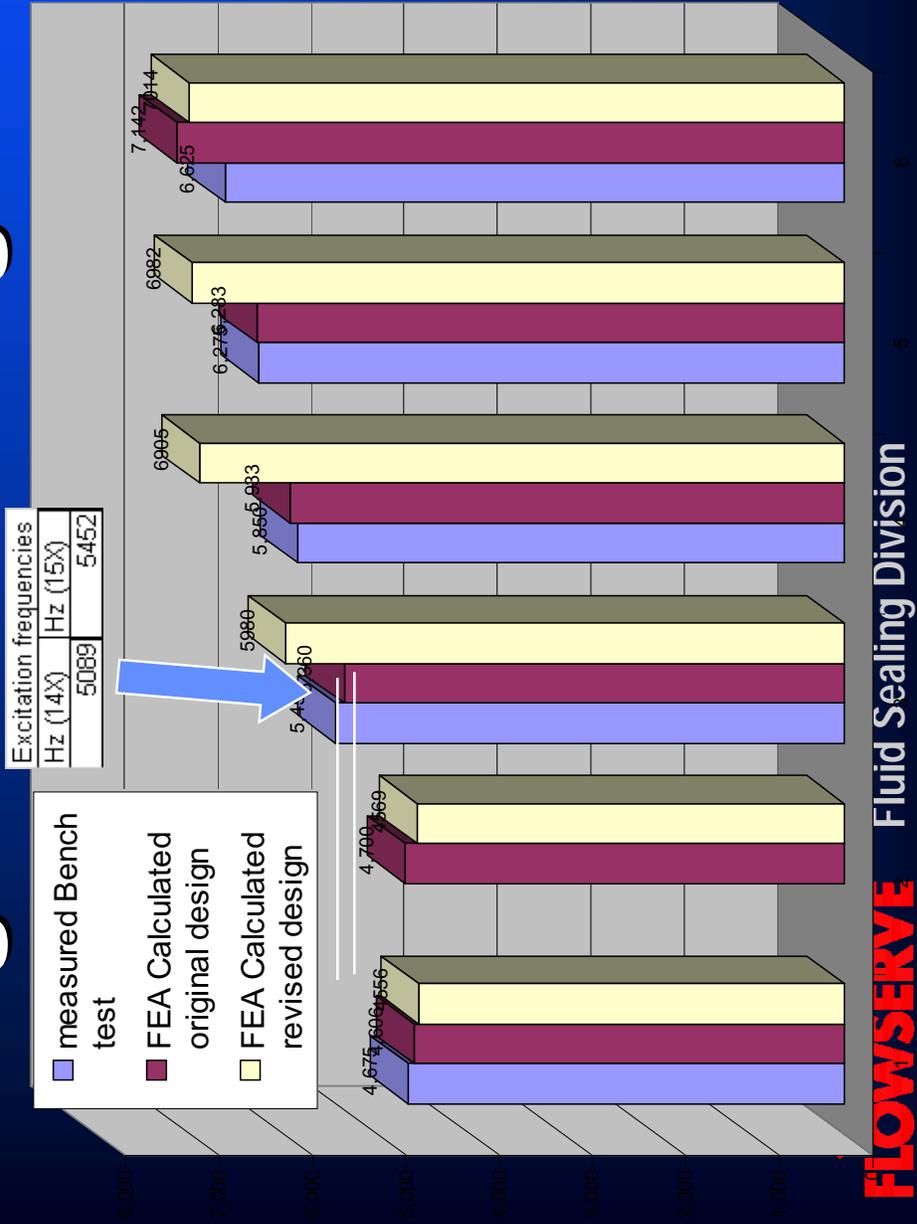


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Accurate model needed to guide re-design

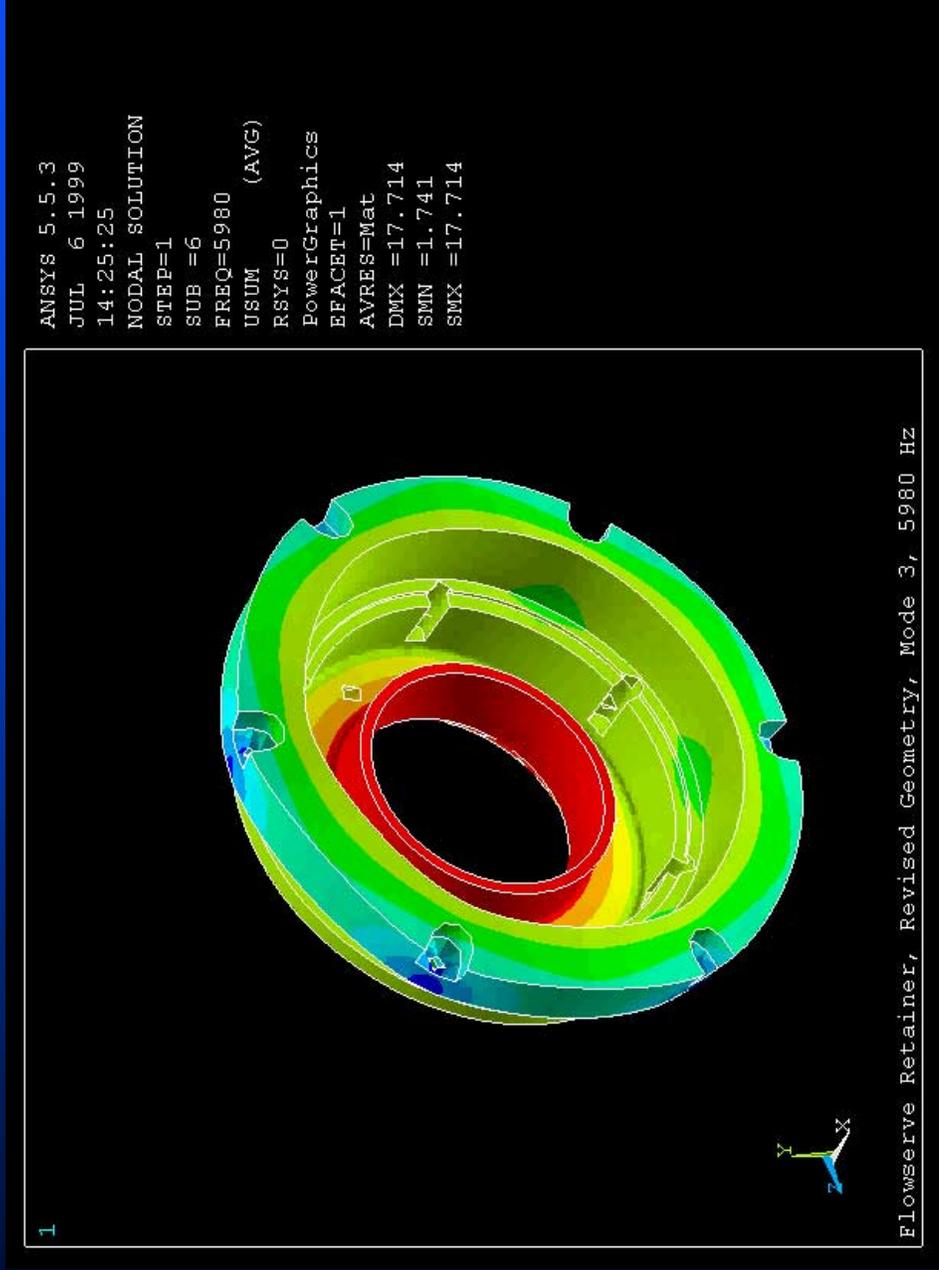


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Redesign natural frequency= 10% higher



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Wrap Up

- Advanced analytical tools allows understanding accurate guide to challenging problems solutions
- Challenges ahead to educate engineers and designers, to use advanced tools to understand the behavior of machinery, aware of its limitations, to use as a guide in improving product performance.
- When qualitative analysis is sufficient, and when precise quantitative analysis is required
- STLE Advanced Projects Subcommittee needs input from end-users on research topics



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